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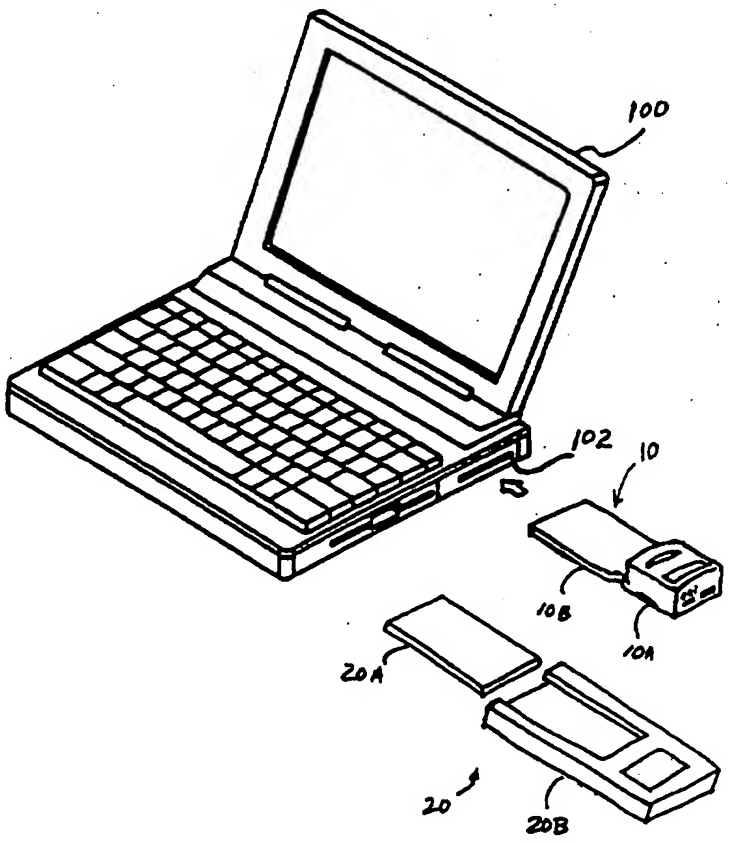
(57) Abstract

A computer peripheral (10) is provided that combines the functionalityof multiple devices, for example a pager (10A), a facsimile (10B) machine, and a data modem (10B). The computer peripheral (10) is designed as one or more separable modules, or functional components, including a module for interfacing the peripheral to a host computer (100). At least one of the functional components can be operated either as part of the computer peripheral, or may be separated from the remainder of the computer peripheral and used as a self-contained functional module when powered by a battery pack (30) or holster (20B). Circuitry and methods are also provided for a stantardized serial interface that allow a host computer (100) to selectively connect to and communicate with one or more PCMCIA based devices connected to the serial bus, and which support a daisy-chain of multiple devices from a single PCMCIA based device.



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METHODS AND APPARATUS FOR MODULAR COMMUNICATIONS DEVICE

Background of the Invention

This invention relates to modular computer peripherals and to circuitry for providing an interface between a host computer and multiple peripheral devices. More particularly, the invention relates to means for interfacing multiple electronic devices such as modems, pagers, faxes, or other circuitry to a host computer via a single PCMCIA slot and to peripherals comprising modular components that are operable independently from the host computer.

Today's working professional relies heavily on modern technology; computers, telephones, modems and facsimile machines have become indispensable office equipment. The mobile professional supplements office-bound equipment with laptop computers, cellular telephones, pagers, and fax/modems to maintain the same degree of connectivity while away from the office.

In an effort to capitalize on the mobile professional's need for an "office-in-a-briefcase", devices which combine the functionality of a pager, a facsimile machine, and a computer modem into a single computer peripheral are desirable. A peripheral device, combining a fax/modem and a radio pager into a single PCMCIA peripheral, such as that disclosed in PCT Publication No. WO 95/18491, published July 6, 1995, would advantageously need only one PCMCIA slot to use both modem and pager communication devices.

Such devices are not without drawbacks, however, and there are instances when a professional does not need, or want, to carry all of the devices in the aforementioned office-in-a-briefcase. For example, while attending a business lunch, the professional may desire to carry only a pager, without bringing a laptop computer.

The device described in PCT Publication No. WO 95/18491 permits removal of the combined pager/fax/modem device from the laptop to provide pager functionality without the laptop. However, due to the specified dimensions of a PCMCIA slot and card, and the need to provide the pager with a battery for power when it is not connected to the computer, the combined pager/modem device requires bulkier packaging than either the pager or PCMCIA modem alone.

In addition, the relatively fragile transition between the thin PCMCIA card portion of the device and the bulkier pager portion of the device is vulnerable to bending stresses. It would therefore be advantageous to be able to separate the pager component of the combined pager/fax/modem peripheral from the remaining components. In this way, the pager may be carried separately or coupled to the remainder of the combination peripheral and installed in a laptop computer, as the user desires.

In order to separate the pager from the remainder of the pager/fax/modem device, circuitry must be provided so that the computer can selectively communicate with either the fax/modem or the pager. Furthermore, the fax/modem portion must be capable of operation regardless of whether the pager is attached or not.

The PCMCIA specification provides for a 15 pin peripheral connector, or auxiliary port, which is intended to allow a PCMCIA card to connect to the

external world. The auxiliary port has been used to connect a PCMCIA device to, for example, a network, a telephone line, or an external floppy diskette drive. Often such connections utilize a subset of the 15 pins available in the auxiliary port connector. Additional circuitry on a PCMCIA device may make it possible to configure some of the unused pins as a serial bus for connecting additional devices to the host computer.

In the device described in the above-mentioned PCT publication, when the pager portion and fax/modem portion of the peripheral are combined, the pager draws power from the laptop computer via the fax/modem PCMCIA card. Since the pager draws power from the laptop, it is not necessary to provide a separate power source (e.g. a battery) for the pager when it is coupled to the fax/modem.

Since the power source for the pager contributes a significant fraction of the total weight of the pager, removing the battery from the pager when it is coupled to the fax/modem would advantageously reduce the weight of the pager and therefore also reduce the stress placed upon the mechanical and electrical joint between the pager portion and the fax/modem portion of the peripheral.

As used herein, the term host computer is used to refer to a general purpose computer system capable of storing, loading, and executing a wide variety of application programs. Host computers typically support large displays and keyboards, as well as many input/output ports for coupling to external devices. An IBM PC compatible, or Apple MacIntosh, are examples of host computers, as that phrase is used herein.

Summary of the Invention

In view of the foregoing, it is an object of the invention to provide a primary PCMCIA device with additional interface circuitry for supporting data communications between an e-mail receiver or pager and a host computer.

It is another object of this invention to provide a computer peripheral comprising one or more independently operable modules that combine the multiple functionalities, for example, those of a pager, a fax machine, and a computer modem.

It is also an object of the invention to provide a data communication protocol that allows a host computer to selectively communicate with either a primary PCMCIA device or a selected one of multiple peripheral devices through a single PCMCIA interface slot.

It is a further object of the present invention to provide circuitry to employ pins of a PCMCIA auxiliary port connector to create a serial bus for connecting additional peripheral devices to a host computer.

It is another object of this invention to provide a modular design for a peripheral combining a pager, fax and modem, in which the peripheral may be used as a pager, independent of a host computer, and additionally, wherein the peripheral includes a pager module that is separable from the remainder of the peripheral.

It is still another object of the invention to provide a means for a pager portion of a modular pager/fax/modem to draw power from a host computer when the pager portion is coupled to the computer via a fax/modem portion of the peripheral.

It is yet another object of the invention to provide a support module, or holster, which can be

coupled to a computer peripheral to provide basic power and user interface functions for the peripheral so the peripheral can be used independently of a host computer.

It is a further object of the invention to provide a support module, or holster, for a computer peripheral having a PCMCIA form factor, such that the holster with the peripheral inserted will have relatively small dimensions, so that it will easily fit in a pocket or can be comfortably clipped on a belt.

These and other objects of the invention are accomplished in accordance with the principles of the present invention by providing a modular computer peripheral in which one or more modules may be separated from and used independently of the remaining peripheral modules. In accordance with the present invention, the modules may include a holster or support module that carries bulky items such as batteries and display devices, so that the peripheral or a functional module thereof can be used separately from a host computer. An interface and protocol is defined for utilizing a subset of the 15 pins in a PCMCIA auxiliary port as a serial expansion bus to permit implementation of certain of the modular features of the invention.

Further features of the invention, its nature and various advantages, will be more apparent from the accompanying drawings and the following detailed description of the preferred embodiments.

Brief Description of the Drawings

FIG. 1 is a perspective view of a host computer and two illustrative embodiments of a modular peripheral constructed in accordance with the present invention.

FIGS. 2A through 2E are perspective views of the first illustrative embodiment of modular peripheral

of FIG. 1.

FIG. 3 is a block diagram showing a host computer and typical internal functional circuitries of the modular peripheral of FIGS. 2.

FIGS. 4A and 4B depict in block diagram form, respectively, the arrangement of a host computer, and a PCMCIA modem, and a host computer, a PCMCIA modem, and an external device, such as a pager or radio e-mail receiver.

FIGS. 5A-C depict pinout diagrams for an auxiliary port connector of a PCMCIA card.

FIG. 6 is a schematic showing in block diagram form typical internal circuitry for a prior art PCMCIA modem.

FIG. 7 is a more detailed block diagram schematic of the modular peripheral of FIG. 3 constructed in accordance with principles of the present invention.

FIG. 8A-C are flow charts illustrating the operation of the auxiliary port interface.

FIGS. 9A through 9D are, respectively, a perspective view of the alternative illustrative embodiment of the modular peripheral of FIG. 2 comprising a fax/modem/pager 20 in a PCMCIA form factor, an illustrative view of a holster to permit independent operation of the pager portion of the modular peripheral of FIG 9A, and cross sectional views modular peripheral of FIG. 9A and of the holster of FIG. 9B.

FIG. 10 is an illustrative block diagram of the internal circuitries of the modular peripheral of FIGS. 9.

Detailed Description of the Invention

The present invention relates generally to the design of modular devices which combine the functionality of several otherwise separate peripherals; which can be coupled to a host computer to act as a computer peripheral; and which also can be operated in a stand-alone mode independent of a host computer. The present invention also relates to methods and circuitry for a host computer to selectively communicate with multiple devices embedded in one or more peripheral expansion cards. Peripherals designed in accordance with the present invention may have multiple functional modules, at least one of which is capable of operation independent of the host computer, and may be separable from the remaining modules of the peripheral device.

A first exemplary embodiment of the invention described hereinafter is that of a modular computer peripheral combining a fax/modem module with a pager module, wherein the pager module is separable from the fax/modem module, and both modules are operable regardless of whether the two modules are coupled to each other or not. An alternative embodiment of the present invention is that of a peripheral comprising a module including fax/modem/pager circuitry in a PCMCIA form factor and a support module or holster that provides power, interface, and display functions for the pager circuitry when the peripheral is not connected to a host computer.

It will be readily apparent to one skilled in the art from the description herein that devices other than pagers and fax/modems could be designed with similar capabilities without departing from the spirit of the present invention. Thus, for example, the fax/modem module may instead, or in addition, include data, voice and cellular capabilities, while the pager

module may include any wireless communications capabilities, including two way communications.

Referring to FIG. 1, alternative embodiments of a modular peripheral constructed in accordance with the present invention are shown. Modular peripheral 10 contains circuitry for providing a variety of communication functions, and is composed of two separable modules: a radio frequency paging module 10A and a fax/modem module 10B. In an alternative embodiment, modular peripheral 20 includes module 20A having circuitry for fax/modem and paging functions, but lacking power and user interface components, and holster 20B for providing support for module 20A when used separately from host computer 100.

Referring now to FIGS. 2A through 2E, details of the first illustrative exemplary modular peripheral 10 are described. In FIG. 2A, pager module 10A is shown coupled to PCMCIA fax/modem module 10B. When inserted into PCMCIA slot 102 of host computer 100 of FIG. 1, fax/modem module 10B is substantially enclosed within host computer 100, with side 11 of pager module 10A substantially abutting the side of host computer 100. PCMCIA card connector 12 provides electrical coupling between peripheral device 10 and host computer 100 to provide for data transfer therebetween, as described hereinafter.

FIG. 2B illustrates pager module 10A separated from fax/modem module 10B. Mechanical coupling between the two modules is provided by tenons 13, which fit into corresponding mortises (not visible in FIG. 2B) in the endface of fax/modem module 10B. A detent mechanism between the mortise and tenons ensures that the two modules do not separate inadvertently. Electrical coupling between the two modules 10A and 10B is provided by 15 pin connector 14 which mates to a standard 15 pin PCMCIA auxiliary port (not visible in

FIG. 2B) on fax/modem 10B.

Referring to FIG. 2C, pager module 10A includes a user interface comprising display area 15 and multi-mode switch 16. The display area 15 is preferably an LCD display and displays menus and messages to the user. Multi-mode switch 16 controls operation of pager module 10A, and is used, for example, in selecting menu options when the pager module is used separately, as described hereinbelow.

Switch 16 preferably is designed with multiple sets of contacts so that the part of the switch pressed by the user is discernable by the circuitry of pager module 10A. The function of the multimode switch is dependent upon the operating mode of the pager, for example, the switch can be used for navigating through menus by pressing various parts of the switch to choose and select menu items, or for scrolling a lengthy message which may be too large to be displayed all at once. Pressing on the right or left side of the multimode switch may then cause, for example, a lengthy message to scroll forward or backward respectively.

In FIGS. 2C and 2D, pager module 10A is shown, respectively, separated from battery pack 30 and coupled to battery pack. Battery pack 30 has a pair of mortises and a 15 pin connector for mechanically and electrically coupling the battery pack to pager module 10A, substantially as describe above in conjunction with coupling between fax/modem module 10B and pager module 10A. Batteries, for example 2 'AAA' cells (not shown), are contained within battery pack 30 to provide power to pager module 10A through 15 pin connector 14. Exemplary battery pack 30 also has flat projection 32, which in cooperation with the pager module, functions as a clip, for attaching the pager to a belt or pocket of the user.

As shown in FIG. 2E, pager module 10A includes three position "on-off" switch 17, which in addition to turning the pager on, also controls whether pager module 10A operates in a "beeping mode" or a silent mode, i.e., upon receipt of an incoming page, the pager either emits audible beeps or vibrates.

Pager module 10A includes feed-through port 18, which is substantially identical to a PCMCIA device auxiliary port connector. As further described hereinbelow with respect to auxiliary port 55 of FIGS. 4A and 4B, port 18 enables fax/modem module 10B to be coupled to a telephone network, even when pager module 10A is attached. Signals from fax/modem 10B are simply passed through from 15 pin connector 14 to feed-through port 18. A conventional adaptor cable may then be plugged into feed-through port 18 to couple fax/modem module 10B to a telephone line.

Referring now to FIG. 3, exemplary circuitry for the first illustrative embodiment of modular peripheral device 10 is described. Modular peripheral 10 preferably includes interface circuitry 40, modem circuitry 42, switching circuitry 43, telephone interface circuitry 44, pager circuitry 46, antenna 48 and display circuitry 50.

Interface circuitry 40 connects modem circuitry 42 and pager circuitry 46 to host 100, which may be a conventional desktop computer, a portable personal computer, personal communicator or other suitable data processing device. Preferably, interface circuitry 40 contains a standard integrated circuit for performing interfacing functions and a universal asynchronous receiver transmitter (UART) for serial to parallel and parallel to serial data conversion, for example, part No. DNE5001, available from the Dr. Neuhaus Engineering Company of Hamburg, Germany. As illustrated in FIGS. 2A and 2B, fax/modem module 10B

conforms to the Type II Extended Personal Computer (PC) Card specification promulgated by the Personal Computer Memory Card International Association (PCMCIA) of Sunnyvale, California.

Modem circuitry 42 enables communication via telephone line 52, and is based on a standard set of integrated circuits that is compatible with most of the widely used modem modulation and control standards. Preferably, modem circuitry 42 has a send and receive facsimile capability and a voice capability, which enables host 100 in combination with modular peripheral 10 to function as a telephone answering machine.

Pager circuitry 46 includes a conventional radio-frequency receiver to perform functions related to wireless communications, such as receiving pages and electronic mail (e-mail) messages, via antenna 48. Paging messages decoded by paging circuitry 46 are displayed on display 50. Paging and e-mail messages received by paging circuitry 46 may also be provided for display or processing to host 100.

Switching circuitry 43 of the present invention is described in greater detail hereinafter with respect to FIGS. 7 and 8A-C. The foregoing circuit components, in combination with switching circuitry 43, enable modular peripheral 10 of the present invention to provide a number of modem/paging/e-mail capabilities not available with previously known devices. Module 10A of modular peripheral 10 performs the functions of conventional pagers/e-mail receivers. Module 10B provides a compact device offering full fax/modem and telephone answering capabilities for a host device. Exemplary detailed circuitries for modules 10A and 10B of modular peripheral 10 are disclosed, for example, in aforementioned PTO Publication No. WO 95/18491.

Referring now to FIGS. 4A and 4B, typical

interconnections among host computer 100, modules 10A and 10B of modular peripheral 10, and wall jack 120 are described. Modem module 10B is constructed in accordance with the PCMCIA specification and includes PCMCIA connector and interface circuitry 40 (see FIG. 3), enabling modem module 10B to be plugged into a PCMCIA expansion slot to make electrical contact with corresponding PCMCIA interface circuitry 104 in host computer 100. PCMCIA interface circuitry 40 and 104 provide a parallel data path, currently 8 or 16 bits, for communicating information between host 100 and modem module 10B. As described hereinabove, modem module 10B also includes standard 15-pin PCMCIA auxiliary port 55 for connection to telephone wall jack 110 through adaptor cable 112.

As shown in FIG. 4B, in accordance with first illustrative embodiment 10 of the present invention, modular peripheral 10 includes the addition of pager module 10A. As in FIG. 4A, modem module 10B and host computer 100 are coupled through PCMCIA interface circuitry 40 and 104. However, interposed between modem module 10B and telephone wall jack 110 is pager module 10A. Pager module is coupled to the modem module by plugging directly into auxiliary port 55 of modem module 10B. Alternatively, an adaptor cable (not shown) could be used to connect pager module 10A to auxiliary port 55. Pager module 10A, which includes standard 15-pin PCMCIA auxiliary port 14 (see FIG. 2B), is connected to telephone system wall jack 110 using adaptor cable 112.

Although the functions of the individual pins of PCMCIA device auxiliary ports have not been standardized by the PCMCIA association, some assignments have become fairly commonplace and some have been formalized by various PCMCIA card manufacturers. FIG. 5A shows a pinout diagram with a

common pin assignment used in previously known PCMCIA modems. Only two signals, TIP and RING are needed to connect to the telephone system; hence, only pins 14 and 15 are used.

A modem interface for use with cellular telephones is also known and its pinout is shown in FIG. 5B. In order to support the complexity of setting up a telephone call via a cellular telephone, additional signal paths are necessary between the modem and cellular telephone. The R_x and T_x signals, pins 4 and 6 respectively, are for data received and transmitted by the modem. Pin 1, GND, provides a common ground or voltage reference between the cellular telephone and the modem. CEL_CLK, pin 10, synchronizes data transfer between the two devices, while pins 2 and 8, DAA/CELL and CEL_BUSY respectively, are used for call setup and monitoring functions.

In order to maintain compatibility with commonly used or formalized interfaces, it is important that the interface employed by the present invention not reuse a previously assigned pin for an incompatible purpose. For this reason, in a preferred embodiment of the present invention, applicable to both modular peripheral 10 described above, and modular peripheral 20 described hereinafter, a pin selection is chosen to be compatible with the pinout of FIGS. 5A and 5B.

Referring to FIG. 5C, a preferred embodiment of the present invention is described in which pin 11 (DATA_FROM_HOST) is used to carry data from host computer 100 to pager module 10A and pin 12 (DATA_TO_HOST) is used to carry data from the pager module to the host. Control of the host-pager module interface is managed by the pager asserting a signal on pin 9 (CONTROL) under direction of the host computer, as described hereinbelow.

With respect to FIG. 6, previously known

internal circuitry 121 of PCMCIA modem 120 is described as forming an illustrative environment for implementation of the present invention. Exemplary internal circuitry is also disclosed in the previously mentioned PTO Publication No. WO 95/18491. Data is transferred in a parallel format between host computer 100 and universal asynchronous receiver-transmitter 122, commonly known as a UART, within the modem, via PCMCIA interface 123. A suitable UART is a NS16550AN integrated circuit (IC) such as those manufactured by National Semiconductor of Santa Clara, California. The parallel data is converted into a serial bit stream by UART 122 and then sent to modem control circuitry 124.

Data pump 125 in conjunction with modem control circuitry 124 encodes the serial bit stream in a manner suitable for transmission through the telephone network. Reception of data occurs in the reverse order, with data pump 125 and modem control circuitry 124 decoding a received signal to recover a serial bit stream. That bit stream is then converted into parallel data by UART 122 for communication to host computer 100.

As is per se known, host computer 100 may send commands to modem 120 to change various configuration parameters that control operation of the modem, for example, setting the modem baud rate. Typically, commands are comprised of a sequence of data values beginning with an attention code or signal, followed by one or more command codes with their associated parameters, and ending with a command termination character. Commands sent to the modem are not recognized or acted upon until receipt of the termination character. Although modems have a default command termination character, many modems have the capability of redefining the command termination character under program control.

With respect to FIG. 7 and in accordance with principles of the present invention, a secondary device, for example pager module 10A, may be coupled to the host computer through auxiliary port 55 of a primary device, for example, fax/modem module 10B. In a preferred embodiment of the present invention, host computer 100 controls the interface to the secondary device by sending a "connect" command comprising a preselected command code to the primary device. The particular command code is programmed into software running on the host computer, possibly as a configuration option, and is selected so that it does not correspond to actual command codes recognized by the primary device. The command code must not include the command termination character currently being used by the primary device, so as to prevent the primary device from acting on the "connect" command.

When host computer 100 later reestablishes a connection with the primary device, the host computer transmits the command termination character for the primary device, terminating any pending command sequences in the primary device. The primary device will then try to act on the command sequence, which was meant for the secondary device. The resulting error message can be used by the host as a way of confirming reestablishment of the connection to the primary device.

In FIG. 7, the secondary device (illustratively pager module 10A) also receives, via the DATA_FROM_HOST line, data sent to the primary device (illustratively, fax/modem module 10B). Upon recognizing the preselected command sequence, the secondary device asserts a control signal. When the control signal is asserted, the data path from the host to the primary device is blocked and a data path from the secondary device to the host is established via the

DATA_TO_HOST line. To discontinue communications with the secondary device, host computer 100 sends another (or even the same) command code to the secondary device, causing it to release the control signal, thereby reestablishing the data paths between the host computer and the primary device.

With reference to FIGS. 3 and 7, pager module 10A is interfaced to fax/modem module 10B that includes modem circuitry 42 and PCMCIA interface 40. Modem circuitry 42 comprises UART 122, modem control circuitry 124, and data pump 125, which function as described above with respect to FIG. 6.

In accordance with the present invention, fax/modem module 10B also includes switching circuitry 130 added in the data paths between UART 122 and modem control circuitry 124. When pager module 10A is not plugged into modem auxiliary port 55 (see FIG. 4A), or when pager module 10A is not asserting the control signal on the CONTROL line, the control signal is driven to a default state by resistor 131. This causes multiplexers (MUXes) 132 and 133 to couple UART 122 to modem control circuitry 124, thus the fax/modem module of modular peripheral 10 functions normally. A suitable MUX for use as MUXes 132 and 133 is a CD4053 triple 2-channel multiplexer/demultiplexer IC manufactured by National Semiconductor of Santa Clara, California.

Serial data sent from UART 122 to modem control circuitry 124 is also sent along the DATA_FROM_HOST line to pager module 10A. When the pager module receives and recognizes a preselected command code, it asserts a control signal on the CONTROL line as described previously herein. An asserted control signal causes MUXes 132 and 133 to disconnect the signal paths between UART 122 and modem control circuitry 124. With the inputs of MUXes 132

and 133 shifted, a mark signal is provided to the input of modem control circuitry 124 by pullup resistor 134. The DATA_TO_HOST line carrying data from pager module 10A is thus supplied to UART 122, to be delivered to the host. Accordingly, serial data from pager circuitry 46 is sent to host computer 100 via MUX 132 and UART 122.

When host computer 100 no longer needs to communicate with pager module 10A, a command code is sent causing pager circuitry 46 to release the control signal on the CONTROL line. This causes MUXes 132 and 134 to restore the signal paths between UART 122 and modem control circuitry 124.

In addition to circuitry in the fax/modem module 10B, control circuitry must be provided in the secondary device, for example pager module 10A, to receive and recognize the connect command and to assert a control signal on the CONTROL line. This control circuitry comprises, for example a microcontroller or microprocessor, although a microsequencer or programmable logic device may also be used. An Intel 8031 microprocessor, available from Intel Corporation of Santa Clara, California, is an exemplary microprocessor suitable for use as control circuitry in the second device.

Furthermore, to preserve modem functionality, all signals on auxiliary port 55 of the fax/modem module 10B are fed through to the corresponding pins on auxiliary port 18 of pager module 10A. This arrangement allows the primary device (fax/modem module 10B) to still be connected to other devices, like alternate telephone equipment, whether or not the secondary device (pager module 10A) is installed.

Referring now to FIGS. 8A-C, operation of an auxiliary port interface in accordance with the present invention is described. An illustrative routine shown

in FIG. 8A is executed on host computer 100 for connecting to a secondary device, for example pager module 10A, via auxiliary port 55. First, the routine checks an internally maintained status indicator, step 200, to determine whether the device is already connected.

If the host is already connected to the secondary device the routine returns an indication of success, step 202. If the connection is not already established then the host sends a connect command, step 204, consisting of a unique command code, to the primary device. The command code may be a single data value, or may be multiple data values sent in sequence, and is unique in the sense that it is not recognized as a command by the primary device. In order to establish a connection, host computer 100 transmits an attention signal, step 206, for example a "break" signal, followed by a connect command, step 208.

After transmitting the connect command, the routine sets up a timeout interval, step 210, and waits for an acknowledgement from the secondary device, step 212. If the acknowledgment is received prior to expiration of the timeout then a successful indication is returned, step 202; otherwise, if the timeout period is determined to have expired, step 216, for example, because the secondary device is not attached, the routine returns an indication of failure, step 214.

An illustrative routine in accordance with the present invention by which a host disconnects from a secondary device attached via an auxiliary port of the primary device, and reconnects to the primary device itself, is shown in FIG. 8B. If the host is already connected to the primary device, step 220, then no action is required, otherwise a disconnect command is sent, step 222. In either case a successful indication is returned, step 224.

Referring now to FIG. 8C, an illustrative routine, executed on the secondary device attached via the auxiliary port of the primary device, is described for establishing a communications link between the secondary device and the host computer. Upon power up or reset, the secondary device enters the disconnected state, box 230, and loops waiting for a connect command. For a two part command code, the device continually receives data sent to the primary device by the host computer, step 232, and monitors that data to detect an attention signal, step 234.

Once an attention signal is received, the secondary device waits for a connect command from the host, step 236. If the next data value received is the connect command, step 238, the secondary device asserts a control signal, step 240, which disconnects the primary device and connects the secondary device, as described hereinabove. Alternatively, if the next data value is not the connect command the secondary device returns to the disconnected state, box 230, and resumes waiting for an attention signal, step 234.

After asserting the control signal, step 240, and establishing a communication path to the host computer, the secondary device transmits an acknowledgement to the host, step 242, and enters the connected state, box 250. In the connected state the secondary device receives commands from the host, step 252, which are executed by the secondary device, step 254.

It is contemplated that commands recognized by the secondary device are application specific, but must include at least connect and disconnect commands. Additional commands may include, for example, commands directing the secondary device to transmit e-mail messages to the host computer, or commands changing configuration parameters of the secondary device. If a

command is a disconnect command, step 256, the secondary device releases the control signal, step 258, and enters the disconnected state, box 230. The communication path from the secondary device to the host is then discontinued and the path between the primary PCMCIA device and host is reestablished.

Numerous variations and embellishments may be made to the interface routines provided in FIGS. 8A-C without departing from the principles of the present invention. For example, if after receipt of an attention signal a second attention signal is received, the secondary device may restart the disconnected state over again, waiting for an attention signal, or the secondary device may continue to wait for a connect command. A check for a timeout condition after receipt of the attention signal and before receipt of the connect command may also be included.

Although the above-described embodiment describes a pager module attached to the auxiliary port of a fax/modem module, one skilled in the art will appreciate that switching circuitry, similar to that shown in FIG. 7, also may be included in pager module 10A or other device connected via the modem auxiliary port. For such an arrangement, a third device, such as a GPS receiver or wireless network interface card, could also be coupled between the pager module auxiliary port 18 and the telephone wall jack 122.

The host computer 100 could then send a first command code to establish a connection to the pager module, as described hereinabove, followed by a second command code causing the GPS receiver to assert a control signal to disconnect the pager and establish a connection with the host computer as described previously.

Alternatively, the switching circuitry may be designed to propagate the control signal up a daisy-

chain of devices, thus allowing the daisy-chained device to switch off, or disconnect, the primary device and all additional devices at one time. Each additional device may have its own unique command code to which it responds, provided that none of the command codes could be recognized by any of the intervening components of the daisy-chain. In this manner, numerous devices could be cascaded in daisy-chain fashion to the primary PCMCIA device and thereby share a single PCMCIA interface.

In yet another embodiment of the present invention, signal lines may be utilized in addition to the DATA_FROM_HOST, DATA_TO_HOST and CONTROL lines. Specifically hardware flow control signals may also be employed to regulate the data transfer rate between host and device. Additionally, a data available signal may be provided for the secondary device to indicate it has data available without first requiring the host to establish a connection with the secondary device to determine its status.

Referring to FIGS. 9A through 9D, alternative modular peripheral 20 of FIG. 1 is described. Modular peripheral 20 includes module 20A containing circuitry for providing a variety of communication functions, including fax/modem and paging functions, as described in connection with peripheral device 10, and holster module 20B that enables operation of selected portions of module 20A when disconnected from host computer 100.

Module 20A conforms to the Type II Extended Personal Computer (PC) Card specification promulgated by the Personal Computer Memory Card International Association (PCMCIA) of Sunnyvale, California. Alternatively, a peripheral designed in accordance with the principles of the present invention may fit on peripheral cards having dimensions either smaller than or larger than a Type II PCMCIA card, depending upon

the amount and type of circuitry incorporated into the peripheral.

When inserted into PCMCIA slot 102 of host computer 100, PCMCIA card connector 21 provides electrical coupling between module 20A and host computer 100 to provide for data transfer therebetween. PCMCIA card connector 21 also provides power from host computer 100 to the circuitry of module 20A.

Retractable antenna 22 remains external to the shell of the host computer and can be extended or retracted as needed to improve reception of radio signals. Attached to antenna 22 is dual use plug 23 which covers an auxiliary port (not shown) of module 20A when the port is not in use, and also functions to hold antenna 22 in its retracted position when it does not need to be extended.

With respect to FIG. 9B, exemplary holster 20B is described that enables modular peripheral 20 to be used as a pager independent of host computer 100. As shown in FIGS. 9C and 9D, holster 20B is shaped so as to form a receptacle into which module 20A may be inserted. Ledges 24 along the length of holster 20B engage shoulders 25 on module 20A and act to retain it in place. Alternatively, the receptacle may be completely enclosed to form a slot into which the PCMCIA form factor peripheral device is inserted.

To provide an electrical interface between the holster 20B and module 20A, a plug 26 made up of parallel pins of various lengths is located at one end of the holster, and is designed to mate with PCMCIA card connector 21 of module 20A. When fully inserted into holster 20B, the pins of plug 26 mate with PCMCIA card connector 21 to provide electric coupling between holster 20B and module 20A. This coupling both provides power to module 20A and provides a path for transferring data between holster 20B and module 20A.

Holster 20B is also provided with a user interface comprising a display area 27 and switches 28A and 28B. The display area 27 is preferably an LCD display and displays menus and messages to the user. Switches 28A and 28B control operation of the pager circuitry of module 20A and are used, for example, in selecting menu options when the device is used as a pager separate from host computer 100.

The function of switches 28A and 28B are dependent upon the operating mode of the pager, for example, one or both switches may be used for navigating through menus by pressing one switch to display several menu items and the other to select a particular menu item. Pressing one of the switches two or more times in rapid succession may be used to change the functions performed by the switches so that instead of navigating through menus, the switches can be used to scroll a lengthy message which may be too large to be displayed all at once.

Other functions provided by switches 28A and 28B may include turning the pager on or off, and selecting whether the pager "beeps" or vibrates when a message is received. Alternatively, switches 28A and 28B may be combined into a single multimode switch as described hereinabove with respect to modular peripheral 10.

As yet another alternative, switches 28A and 28B may be replaced by, or augmented by, voice recognition circuitry. Special purpose integrated circuits, such as the MSM6679 voice recognition processor (VRP) manufactured by OKI Semiconductor of Sunnyvale, California, for example, offer speaker independent voice recognition for limited vocabularies, as well as speech generation capabilities for voice prompting. This would allow verbal commands, such as "scroll" or "next", to scroll the display or display

the next message, instead of, using buttons and menu selections. Although, voice recognition technology may be used to eliminate the need for buttons or switches, retaining the switches provides for a "silent" mode of user-device interaction.

In addition to the display and switches, holster 20B also contains a power supply 29, for example 2 'AAA' cells (not shown), to provide power to the pager circuitry of module 20A through plug 27. Holster 20B may also include a belt clip (not shown) for attaching the pager to a belt or pocket of the user.

Referring now to FIG. 10, the internal circuitry of modular peripheral 20 is described. Portions of the internal circuitry of module 20A that correspond to portions of the internal circuitry of modular peripheral 10 are referred to by like numerals (see FIG. 3). In the illustrative embodiment depicted in FIG. 10, module 20A includes PCMCIA interface circuitry 40, modem circuitry 42, switching circuitry 43, telephone line interface 44, pager circuitry 46 and antenna 48.

Switching circuitry 43, includes switching circuitry 130 as described above with respect to FIG. 7, so that host computer 100 may selectively communicate with either the fax/modem circuitry or the pager circuitry of modular peripheral 20. Operation of this circuitry is as described above with respect to modular peripheral 10 in connection with FIGS. 7 and 8A-C.

Module 20A preferably receives power from host computer 100 via PCMCIA interface 40 so a separate power source (e.g. a battery) is not required when the peripheral is installed in the host. Software executed on host computer 100 is used to control the operation of the circuitry of module 20A and to effect data

transfers between host computer 100 and fax/modem circuitry 32 and pager circuitry 36.

In addition, the software preferably provides a user interface to the circuitry of module 20A, allowing a user to set operating modes and parameters of the fax/modem, as well as to select and display messages received and decoded by pager circuitry 46. Therefore, it is not necessary to provide pager circuitry 46 with a built-in user interface when module 20A is installed in host computer 100. Rather, by removing the bulky battery and user interface components, the pager/fax/modem circuitry can be dimensioned to fit on a single PCMCIA peripheral card.

Still referring to FIG. 10, holster 20B includes a power supply and a user interface 49 for those instances when modular peripheral 20 is to be used as a stand-alone pager. Holster 20B therefore preferably includes interface circuitry 47, an output device (display 27), an input device (switches 28A and 28B), and battery 29. Interface circuitry 47 enables a user to operate pager circuitry 46 via input device 28 and output device 27, for example, to receive radio pages. As described with respect to FIGS. 9A-9D, holster 20B is adapted to accept PCMCIA card connector 21 via plug 26.

The above description of the present invention is presented in terms of a modular computer peripheral combining the functionality of a pager, a facsimile machine, and a data modem; however, many other devices could be effectively combined into a single peripheral using the principles presented above. As noted above, for example, the fax/modem module may instead, or in addition, include data, voice and cellular capabilities, while the pager module may include any wireless communications capabilities, including two way communications. Other circuitry

which could benefit from the principles of this invention include cellular telephone, navigation equipment, wireless LAN adapters, or data storage devices.

However, it is not necessary to include a fax/modem and/or pager circuitry within the peripheral device. Other devices which are useful as both a peripheral and stand-alone device, such as cellular telephones or Global Positioning System receivers, can be used instead of or in addition to the pager and fax/modem circuitry without departing from the scope and spirit of the present invention.

It will be therefore be understood that the foregoing is merely illustrative of the present invention, and that various modifications can be made by those skilled in the art without departing from the scope and spirit of the invention.

What Is Claimed Is:

1. A data communication device comprising:

a modem module having modem circuitry, first interface circuitry for selectively coupling the modem circuitry to a host computer and second interface circuitry for coupling the modem circuitry to a telephone line;

a pager module having pager circuitry, the pager module removably coupled to the modem module, the pager circuitry operating in a first mode to transmit wireless messages to the host computer via the first interface circuitry, and in a second mode, when uncoupled from the modem module and removably coupled to a battery pack, to receive wireless messages; and

switching circuitry disposed in the modem module and having a first operational state wherein the modem circuitry is coupled to the first interface circuitry to enable the host computer to communicate via the telephone line and a second operational state wherein the pager circuitry is coupled to the first interface circuitry to operate in the first mode.

2. The data communication device as defined in claim 1 wherein the pager module draws power from the host computer when removably coupled to the modem module.

3. The data communication device as defined in claim 1 wherein the pager module further comprises a battery pack, the pager module removably coupled to the battery pack when the pager module is uncoupled from the modem module.

4. The data communication device as defined in claim 1 wherein the switching circuitry defaults to

the first operational mode when the pager module is uncoupled from the modem module.

5. The data communication device as defined in claim 1 wherein the first interface circuitry is compatible with PCMCIA expansion slot specifications for a Type II PCMCIA slot.

6. The data communication device as defined in claim 1 wherein the modem module is contained within a card having external dimensions suitable for insertion in a PCMCIA expansion slot that is a Type II PCMCIA slot.

7. The data communication device as defined in claim 1 wherein the modem circuitry includes circuitry to receive and transmit facsimile data via the telephone line.

8. The data communication device as defined in claim 1 wherein the pager circuitry receives pager messages.

9. The data communication device as defined in claim 1 wherein the pager circuitry receives alphanumeric e-mail messages.

10. The data communication device as defined in claim 1 wherein the modem module further comprises

an auxiliary port having a DATA_FROM_HOST line, a DATA_TO_HOST line, and a CONTROL line;

a data path coupling the first interface circuitry to the DATA_FROM_HOST line, so that data transmitted by the host computer through the first interface circuitry is serially transmitted on the DATA_FROM_HOST line; and

wherein the switching circuitry is coupled to the first interface circuitry, to the modem circuitry, and to the DATA_TO_HOST and CONTROL lines, the switching circuitry responsive to a control signal asserted on the CONTROL line, and selectively changeable between a first state wherein the modem circuitry is connected to the first interface circuitry and the DATA_TO_HOST line is disconnected from the first interface circuitry, and a second state wherein the modem circuitry is disconnected from the first interface circuitry and the DATA_TO_HOST line is connected to the first interface circuitry.

11. The data communication device as defined in claim 10 wherein the pager module removably connects to the auxiliary port, and wherein the pager circuitry further comprises control circuitry removably coupled to the DATA_TO_HOST, DATA_FROM_HOST, and CONTROL lines, via the connection to the auxiliary port, so that the control circuitry asserts a control signal on the CONTROL line responsive to a first predetermined data sequence on the DATA_FROM_HOST line, and removes the control signal from the CONTROL line responsive to a second predetermined data sequence on the DATA_FROM_HOST line.

12. The data communication device as defined in claim 11 wherein each of the first and second predetermined data sequences comprises an attention code followed by a command code.

13. The data communication device as defined in claim 10 wherein the data path coupling the first interface circuitry to the DATA_FROM_HOST line further comprises parallel-to-serial data conversion circuitry.

14. A pager module adapted to be removably coupled to a modem module coupled to a host computer, the module modem having modem circuitry and switching circuitry including a DATA_TO_HOST line, a DATA_FROM_HOST line and a CONTROL line, the pager module comprising:

pager circuitry for receiving wireless communications, the pager circuitry including control circuitry coupled to the DATA_TO_HOST, DATA_FROM_HOST and CONTROL lines,

the control circuitry asserting a first control signal on the CONTROL line responsive to a first predetermined data sequence received on the DATA_FROM_HOST line, so that the switching circuitry enters a first operational mode wherein the pager circuitry communicates with the host computer via the DATA_TO_HOST line, and asserting a second control signal on the CONTROL line responsive to a second predetermined data sequence received on the DATA_FROM_HOST line, so that the switching circuitry enters a second operational mode wherein the modem circuitry is coupled to the host computer and the pager circuitry is disconnected from the host computer.

15. The pager module as defined in claim 14 wherein the pager module operates, when uncoupled from the modem module, to receive wireless communications.

16. The pager module as defined in claim 14 further comprising a battery pack, the pager module removably coupled to the battery pack when the pager module is uncoupled from the modem module.

17. Circuitry for selectively establishing a data path between a host computer and either a first circuitry for performing a first task or a second circuitry for performing a second task, the first circuitry and the second circuitry located on at least one peripheral module, the circuitry comprising:

interface circuitry coupling the at least one peripheral module to the host computer for transferring data therebetween;

a DATA_FROM_HOST line coupled to the second circuitry;

a data path coupled between the interface circuitry, and the DATA_FROM_HOST line, the data path operative to serially transmit on the DATA_FROM_HOST line data transmitted by the host computer to the at least one peripheral module;

a DATA_TO_HOST line coupled to the second circuitry;

a CONTROL line coupled to the second circuitry; and

switching circuitry coupled to the interface circuitry, to the first circuitry, and to the DATA_TO_HOST and CONTROL lines, the switching circuitry responsive to a control signal on the CONTROL line and selectively changeable between a first state wherein the first circuitry is connected to the interface circuitry and the DATA_TO_HOST line is disconnected from the interface circuitry, and a second state wherein the first circuitry is disconnected from the interface circuitry and the DATA_TO_HOST line is connected to the interface circuitry to thereby connect the second circuitry to the host computer.

18. A data communication device including the circuitry as defined in claim 17 wherein the first circuitry comprises modem circuitry.

19. A data communication device including the circuitry as defined in claim 17 wherein the second circuitry comprises pager circuitry.

20. A data communication device including the circuitry as defined in claim 17 wherein the first circuitry comprises modem circuitry located on the at least one peripheral module and the second circuitry comprises pager circuitry located on a second peripheral module, the second peripheral module removable coupled to the at least one peripheral module.

21. A data communication device as defined in claim 20 wherein the circuitry further comprises circuitry for biasing the CONTROL line to a predetermined, non-asserted state when the second peripheral module is not coupled to the at least one peripheral module.

22. Circuitry as defined in claim 17 wherein the interface circuitry comprises circuitry operable in accordance with PCMCIA expansion slot specifications.

23. Circuitry as defined in claim 17 wherein each of the first and second predetermined data sequences comprise an attention code followed by a command code.

24. Circuitry as defined in claim 17 wherein the data path coupling the interface circuitry to the DATA_FROM_HOST line further comprises parallel-to-

serial data conversion circuitry.

25. Circuitry for controlling switching circuitry of a peripheral card coupled to an expansion slot of a host computer, the switching circuitry selectably connecting a data path between a host computer and either a first functional circuitry or a second functional circuitry, the circuitry comprising:

circuitry for receiving serial data from the host computer;

circuitry for comparing received serial data with a plurality of preselected command codes; and

circuitry for sending a control signal to the switching circuitry, so that the control signal is asserted when the received serial data matches a first preselected one of the command codes, and so that the control signal is released when the received serial data matches a second preselected one of the command codes.

26. Circuitry as defined in claim 25 wherein in response to a preselected one of the command codes, data is serially transmitted from the second functional circuitry to the host computer via the switching circuitry.

27. A data communication device comprising:

a communication module including pager circuitry for receiving and decoding radio frequency transmissions, and interface circuitry for coupling the pager circuitry to a host computer; and

a holster adapted for receiving the communication module, the holster comprising a power supply, user interface, and interface circuitry for coupling the power supply and user interface to the

pager circuitry.

28. The communication device as defined in claim 27 wherein the communication module further includes:

fax circuitry for sending and receiving facsimile transmissions; and

modem circuitry for sending and receiving data transmissions.

29. The communications device as defined in claim 27 wherein the communication module comprises a peripheral card conforming to standards of the Personal Computer Memory Card Interface Association.

30. A modular pager adapted for use as a computer peripheral and as a stand-alone pager, the modular pager comprising:

a first module including

a housing conforming to a mechanical specification of the Personal Computer Memory Card International Association (PCMCIA), the housing having a socket disposed at a first end thereof,

radio receiver circuitry for receiving radio frequency data transmissions,

interface circuitry coupled to the radio receiver circuitry and to the socket, the interface circuitry and socket conforming to a PCMCIA electrical interface specification, so that the radio receiver circuitry can be coupled to a PCMCIA slot in a host computer; and

a second module comprising

a housing having a compartment adapted for receiving a battery and including terminals for electrically engaging the battery, the housing further comprising a portion defining a receptacle adapted for

accepting said first module;

a plug disposed in the receptacle, the plug adapted for mating with the socket to provide electrical coupling thereto;

a user interface comprising display circuitry and input circuitry, the display circuitry and input circuitry mounted in the housing of the second module; and

circuitry coupled to the user interface, to the plug, and to the terminals, wherein the circuitry provides for transfer of data between the radio receiver circuitry of the first module and the user interface of the second module.

31. The modular pager as defined in claim 30 wherein the circuitry of the second module converts data received from the radio receiver circuitry for display by the display circuitry, and wherein the circuitry of the second module, responsive to data from the user input circuitry, provides commands to the radio receiver circuitry.

32. A method of enabling a host computer to communicate by a telephone line and wireless messaging using a data communication device comprising a first portion having interface circuitry, modem circuitry and switching circuitry and a second portion including control circuitry and pager circuitry for receiving wireless messages, the method comprising steps of:

coupling the data communication device to the host computer;

issuing a first predetermined data sequence by the host computer to the control circuitry;

providing a first control signal from the control circuitry to the switching circuitry responsive to the first predetermined data sequence; and

responsive to the first control signal, setting the switching circuitry to a first state wherein the modem circuitry is coupled to the interface circuitry to enable the host computer to communicate via the telephone line.

33. The method as defined in claim 32 further comprising a step of providing a second predetermined data sequence to the control circuitry, providing a second control signal to the switching circuitry, and responsive to the second control signal, setting the switching circuitry to a second state wherein the second portion is coupled to the interface circuitry to enable the host computer to communicate with the pager circuitry.

34. The method as defined in claim 32 further comprising a step of supplying power from the host computer to the second portion to enable the second portion to receive wireless messages.

35. The method as defined in claim 32 wherein the first portion comprises a modem module and the second portion comprises a pager module, the pager module removably coupled to the modem module, the method further comprising steps of:

uncoupling the pager module from the modem module to cause the modem circuitry to be coupled to the interface circuitry; and

operating the host computer to communicate through the modem circuitry and interface circuitry with the telephone line.

36. The method as defined in claim 32 wherein the first portion comprises a modem module and the second portion comprises a pager module, the pager

module removably coupled to the modem module, the method further comprising steps of:

uncoupling the pager module from the modem module;

providing a battery pack;

removably coupling the battery pack to the pager module; and

supplying power to the pager module from the battery pack to enable the pager module to receive wireless messages.

37. The method as defined in claim 32 wherein the first portion and the second portion comprise a peripheral card having a PCMCIA form factor, the method further comprising steps of:

uncoupling the peripheral card from the host computer;

providing a holster having a input means, output means, and a power source;

removably coupling the peripheral card to the holster; and

supplying power to the peripheral card from the power source to enable the pager circuitry to receive wireless messages.

38. A method for a host computer to selectively communicate with either a first circuitry for performing a first peripheral task or a second circuitry for performing a second peripheral task, the method comprising the steps of:

transmitting data from the host computer to the second circuitry at substantially the same time as the data is transmitted to the first circuitry;

transmitting a preselected data sequence representing a command code from the host

computer to the first and second circuitries;

generating a control signal by the second circuitry responsive to the second circuitry receiving a first preselected data sequence from the host;

changing states of switching circuitry within the first circuitry responsive to the control signal, wherein the states of the switching circuitry include a first state wherein the first circuitry is coupled to the host computer and the second circuitry is disconnected from the host computer, and a second state wherein the first circuitry is disconnected from the host computer and the second circuitry is connected to the host computer.

39. The method as defined in claim 38 further including the step of transmitting an acknowledgement from the second circuitry to the host computer after the step of generating the control signal and the step of changing the state of the switching circuitry.

40. The method as defined in claim 38 further including the step of releasing the control signal by the second circuitry in response to the second circuitry receiving a second preselected data sequence from the host computer.

41. The method as defined in claim 38 wherein the step of sending a preselected data sequence comprises sending an ASCII "break" code followed by a preselected data value.

42. The method as defined in claim 38 wherein the second circuitry may be uncoupled from the first circuitry, the method further including a step of biasing the control signal to a predetermined, default state when the second circuitry is uncoupled from the first circuitry.

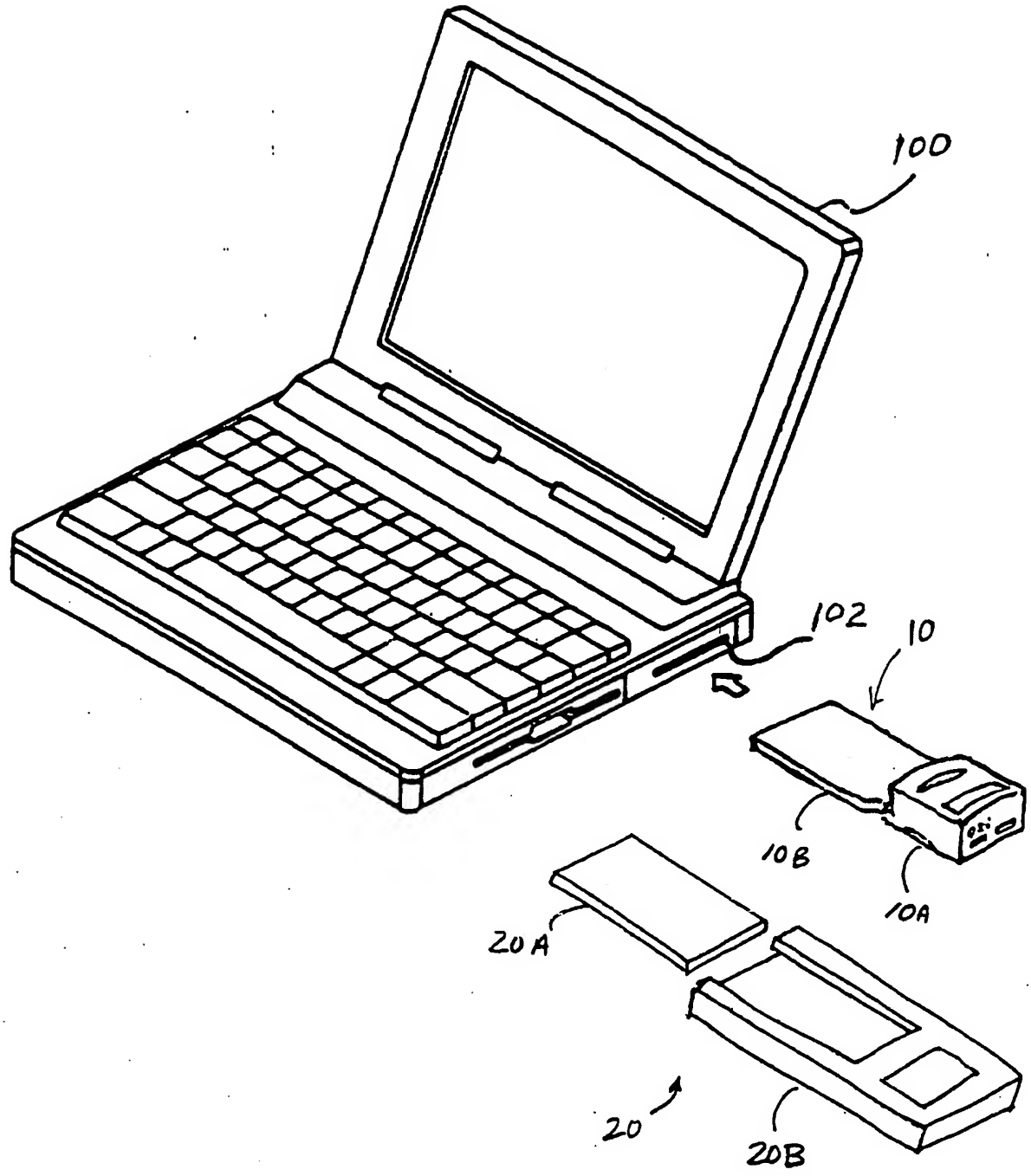


FIG. 1

FIG. 2A

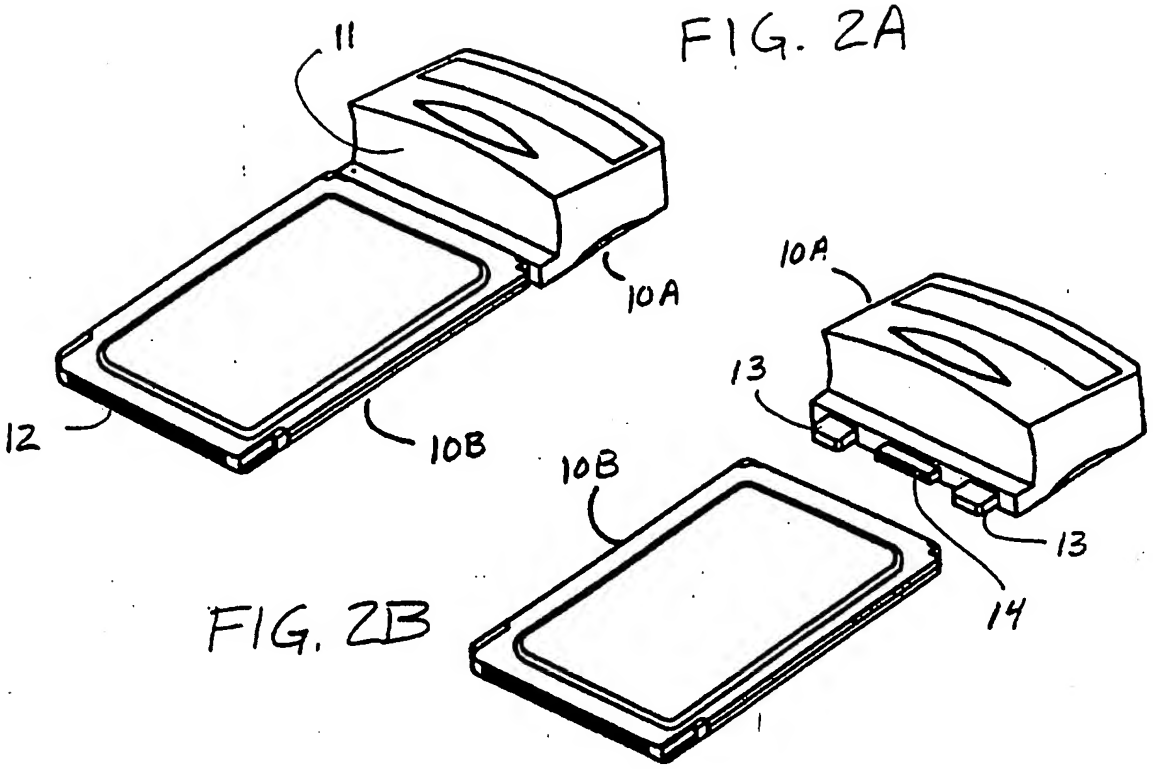


FIG. 2B

FIG. 2C

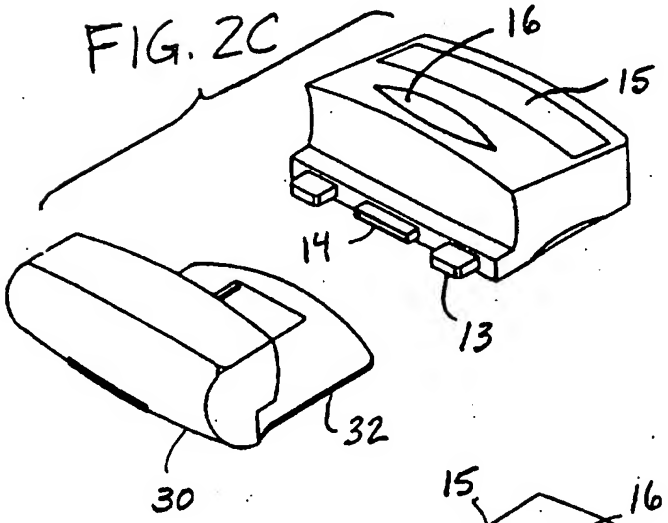
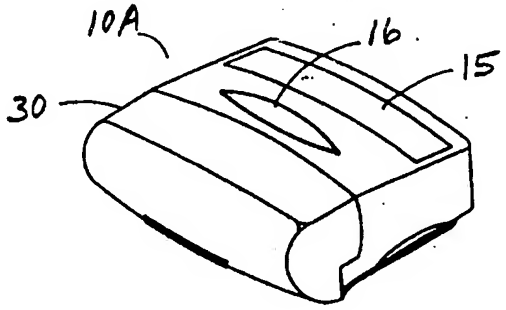


FIG. 2D



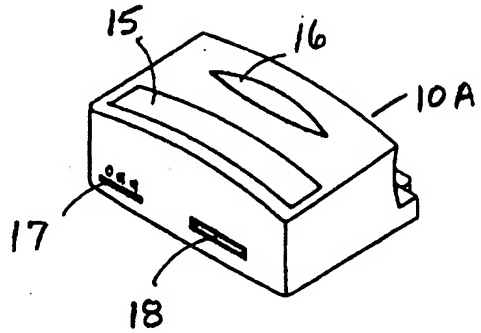


FIG. 2E

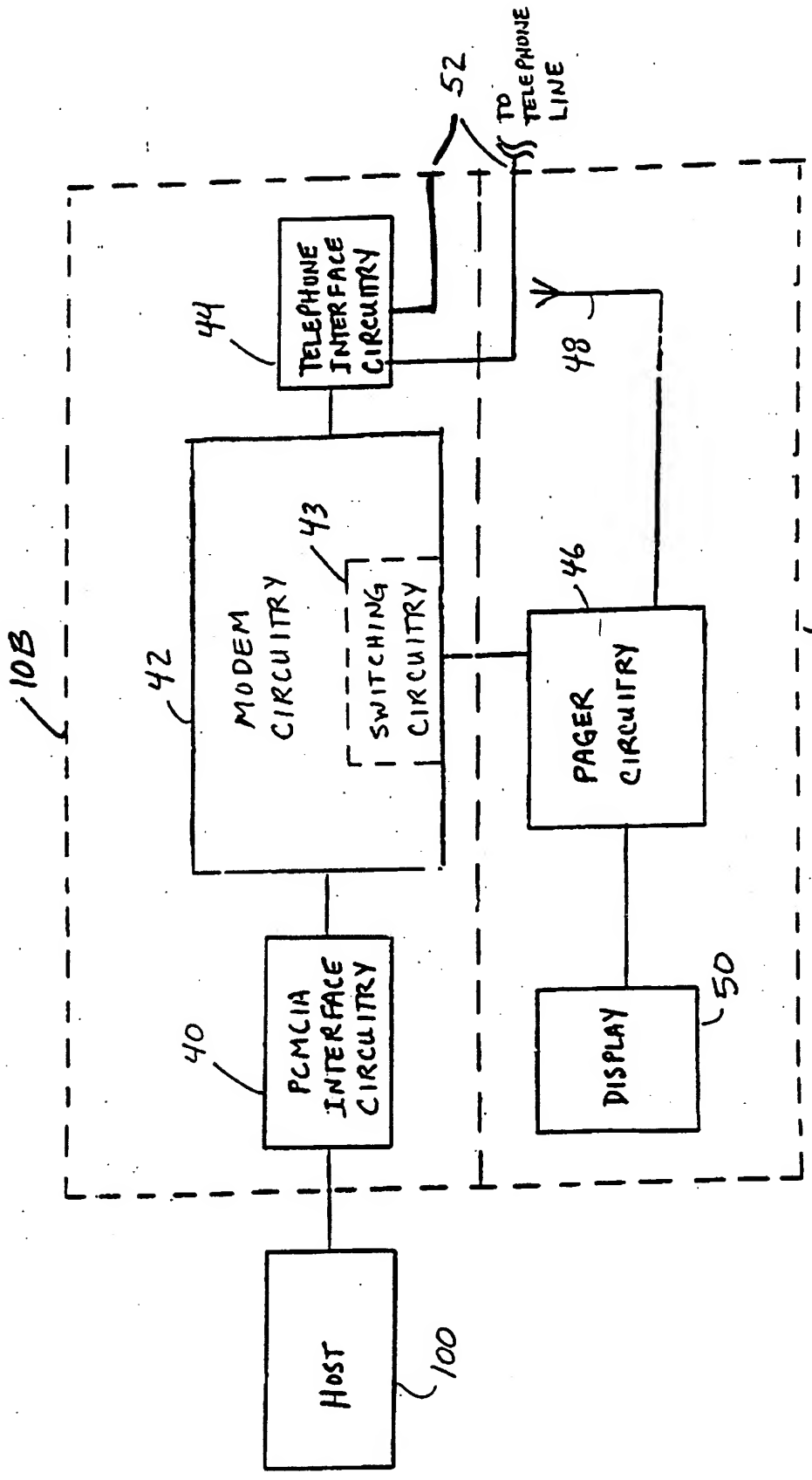

52
TO TELEPHONE LINE
TELEPHONE INTERFACE CIRCUITRY
44
48
MODEM CIRCUITRY
42
SWITCHING CIRCUITRY
43
PAGER CIRCUITRY
46
10B
10A
PCMCIA INTERFACE CIRCUITRY
40
DISPLAY
50
HOST
100

FIG. 3

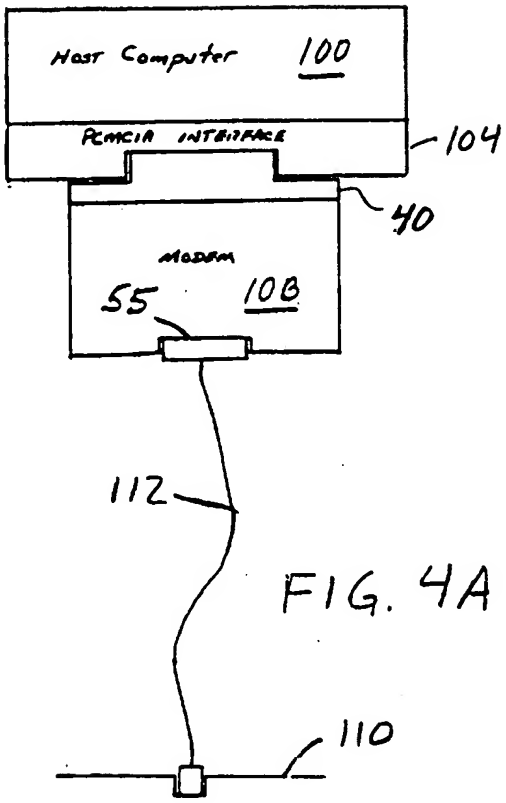


FIG. 4A

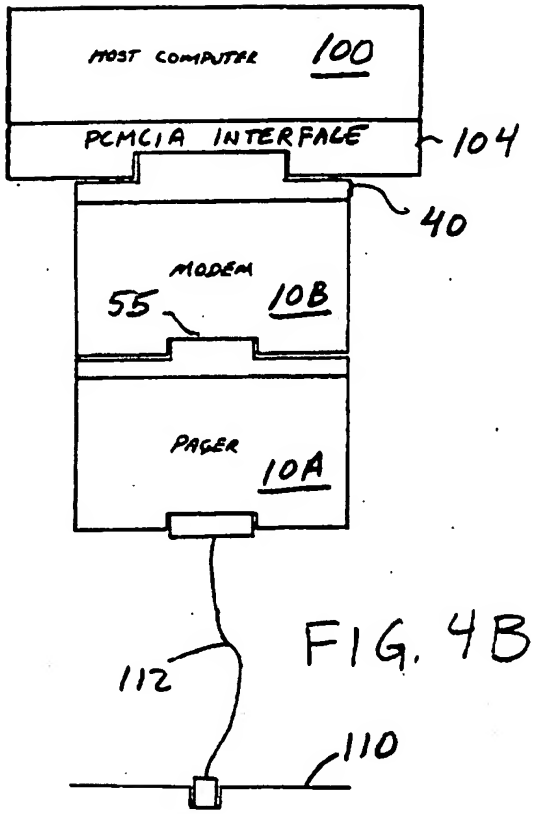


FIG. 4B

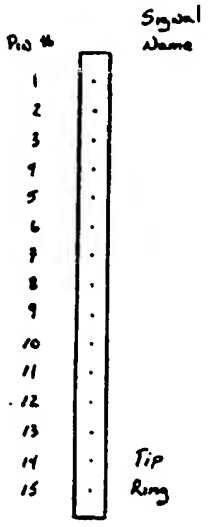


FIG. 5A
PRIOR ART

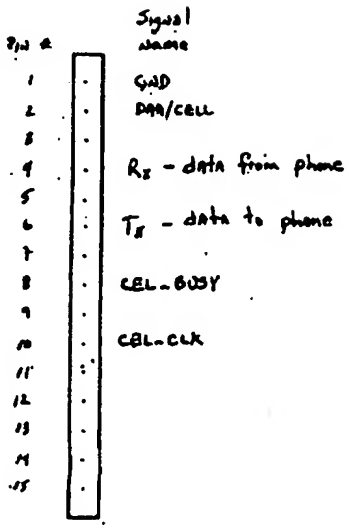


FIG. 5B
PRIOR ART

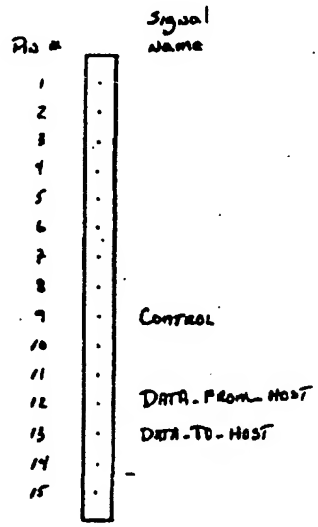


FIG. 5C

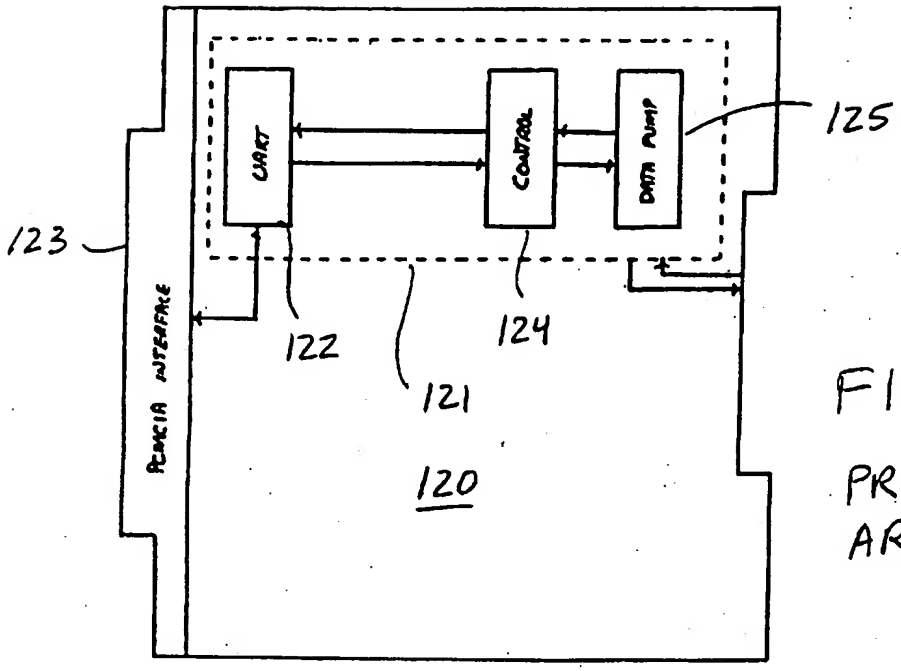


FIG. 6
PRIOR ART

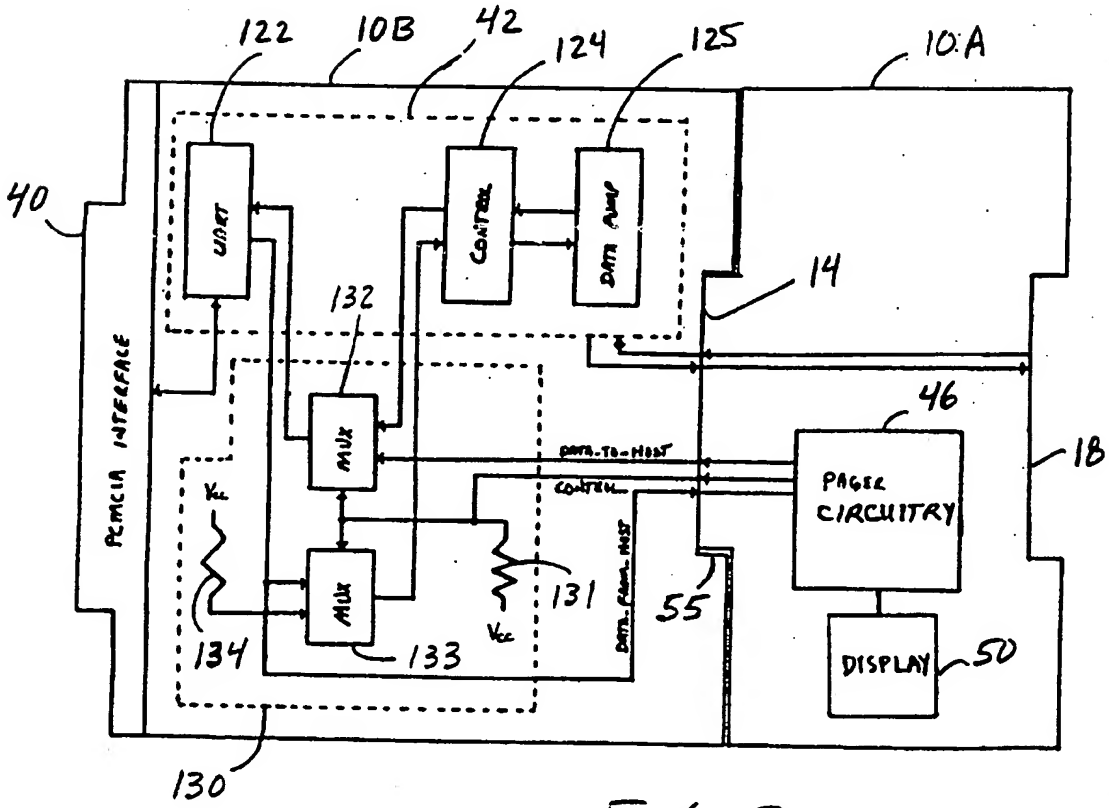


FIG. 7

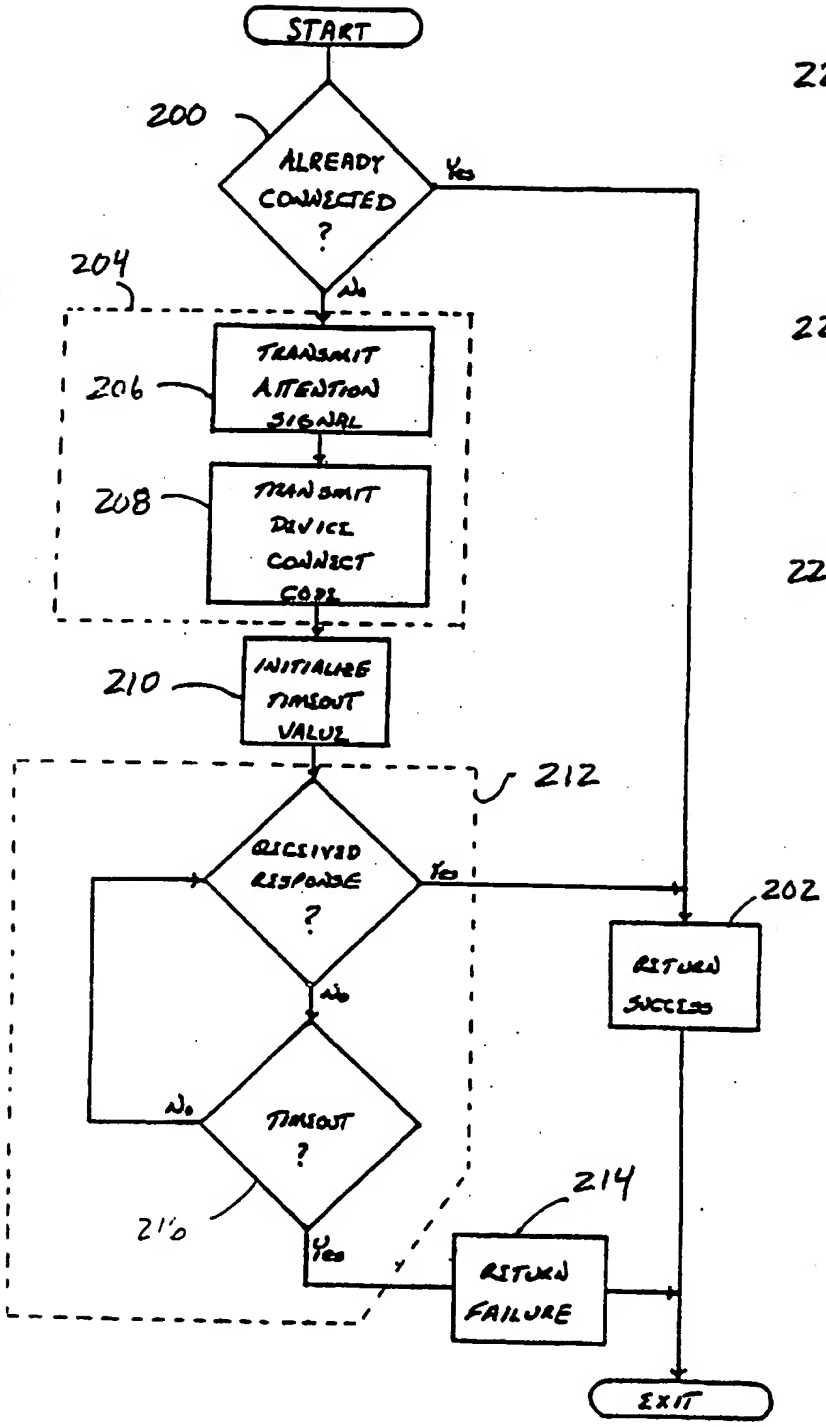


FIG. 8A

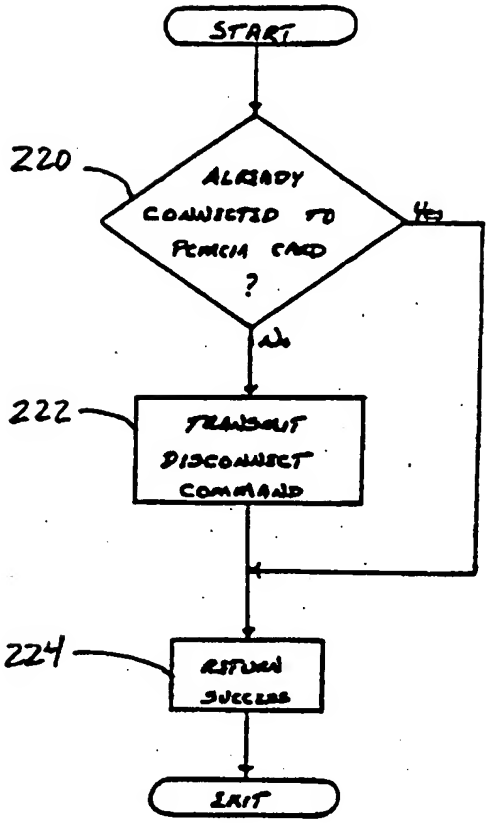


FIG. 8B

BNS Da

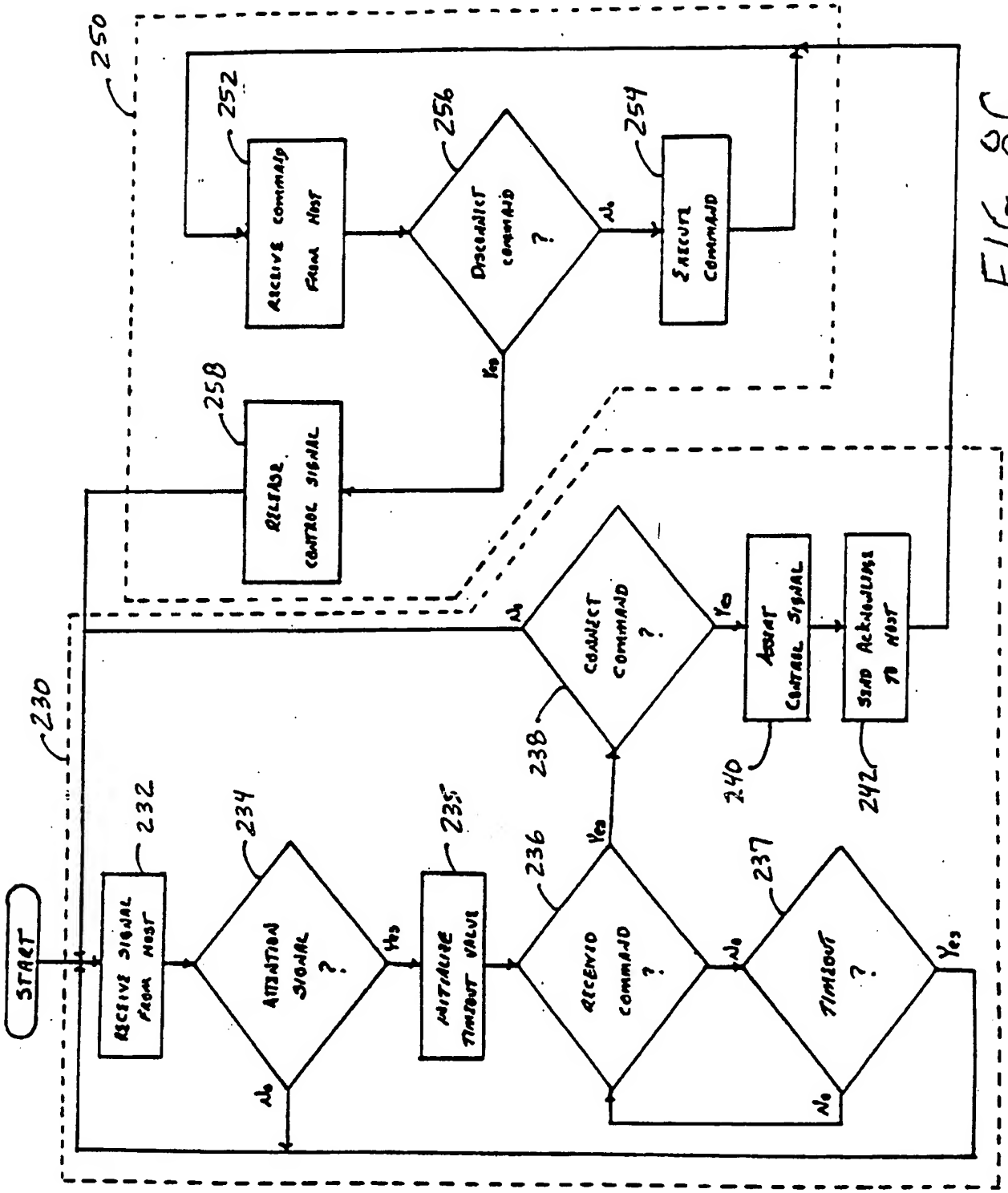

START
230
RECEIVE SIGNAL FROM HOST
232
ATTENTION SIGNAL ?
234
INITIALIZE TIMEOUT VALUE
235
RECEIVE COMMAND ?
236
TIMEOUT ?
237
CONNECT COMMAND ?
238
ASSERT CONTROL SIGNAL
240
SEND ACKNOWLEDGE TO HOST
242
250
RECEIVE COMMAND FROM HOST
252
DECODE COMMAND ?
256
EXECUTE COMMAND
254
RELEASE CONTROL SIGNAL
258
Yes
No

FIG. 8C

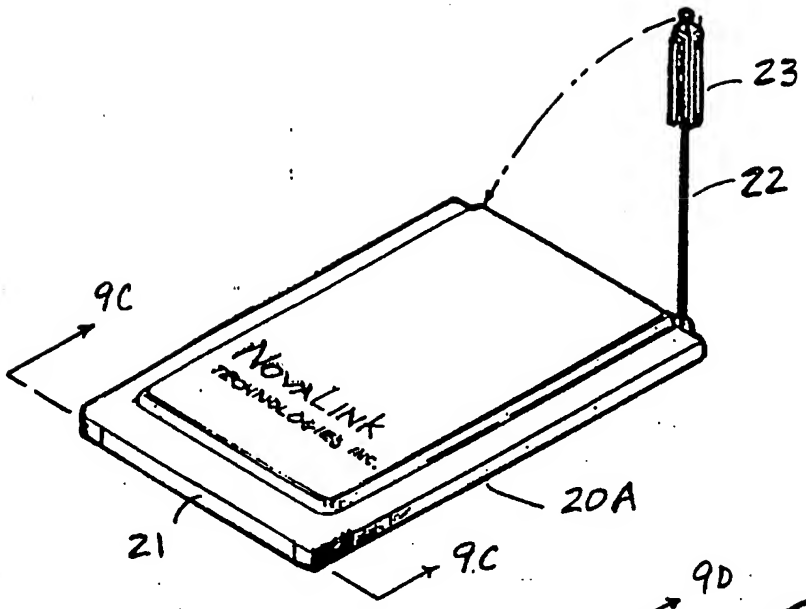


FIG. 9A

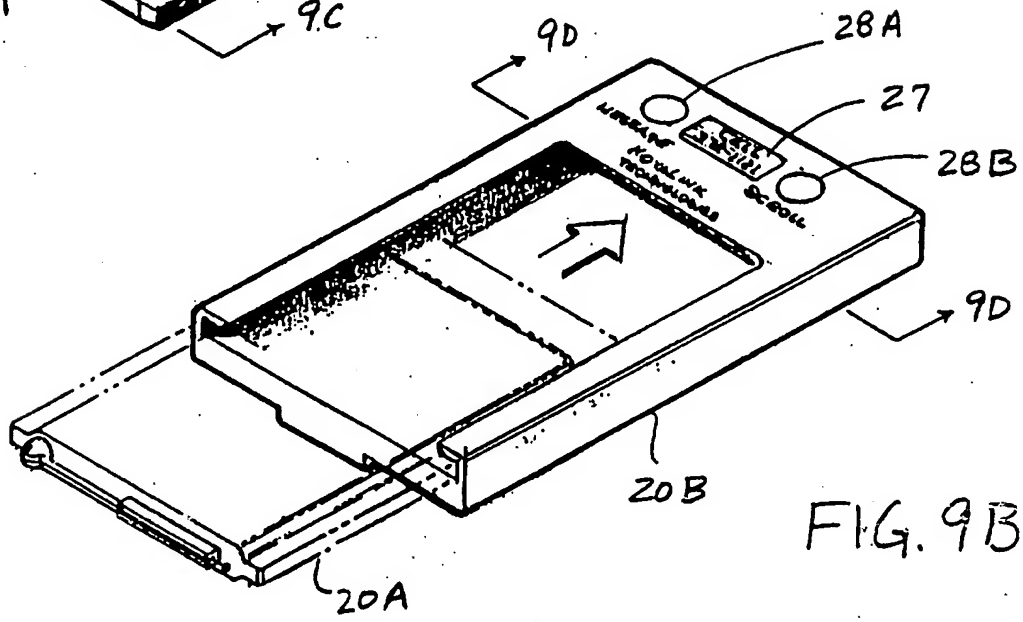


FIG. 9B

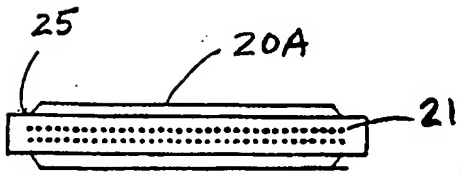


FIG. 9C

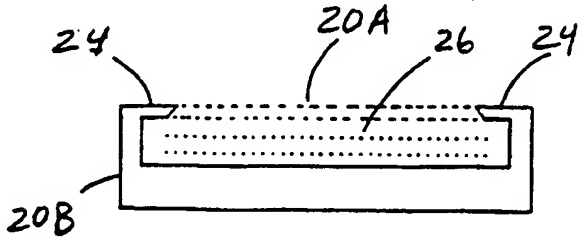


FIG. 9D

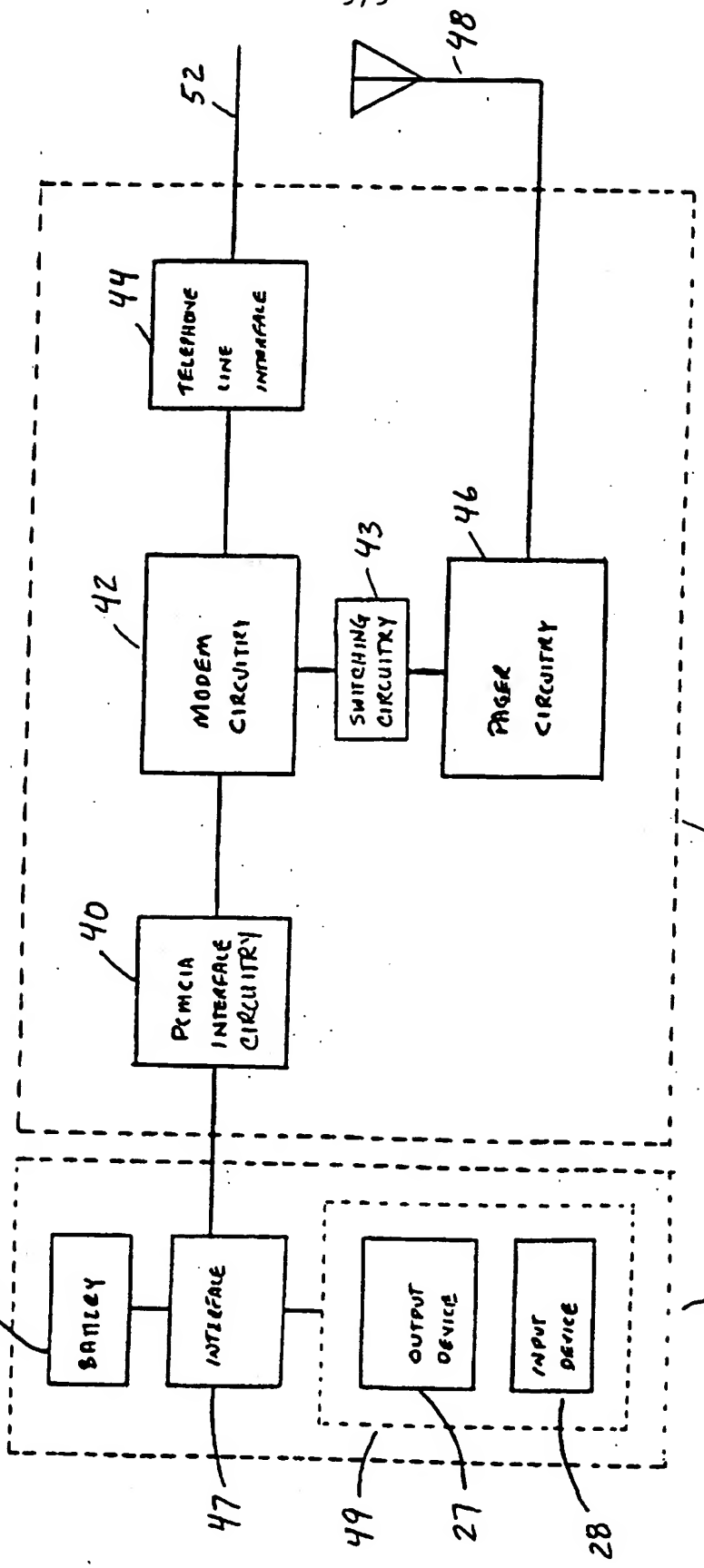

52
48
44
TELEPHONE LINE INTERFACE
42
MODEM CIRCUITRY
43
SWITCHING CIRCUITRY
46
PAGER CIRCUITRY
20A
40
PCMCIA INTERFACE CIRCUITRY
29
BATTERY
INTERFACE
OUTPUT DEVICE
INPUT DEVICE
20B
47
49
27
28

FIG. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US95/12287

A. CLASSIFICATION OF SUBJECT MATTER
IPC(6) :G06F 13/00
US CL :395/281
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 395/280, 281, 282, 822; 375/222; 379/58; 455/38.2; 340/825.44

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

APS

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y -- A	US, A, 5,337,044 (FOLGER ET AL) 09 August 1994, see abstract, figures 1 and 2, col. 5, lines 38-58, col. 8, lines 1-50.	1-13 ------- 14-16, 27-37
Y	US, A, 4,661,972 (KAI) 28 April 1987, see abstract and col. 5-6.	1-13
Y	US, A, 4,682,352 (DURHAM) 21 July 1987, see figure.	1-13
Y	US, A, 5,040,204 (SASAKI ET AL) 13 August 1991, see abstract and col. 7, lines 25-68, col. 8, lines 1-23.	1-13
Y	US, A, 5,249,218 (SAINTON) 28 September 1993, see figures 1A and 3 and col. 13, lines 3-52.	17-26, 38-42

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

*	Special categories of cited documents:	"T"	later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"A"	document defining the general state of the art which is not considered to be part of particular relevance	"X"	document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"E"	earlier document published on or after the international filing date	"Y"	document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"L"	document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"&"	document member of the same patent family
"O"	document referring to an oral disclosure, use, exhibition or other means		
"P"	document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search	Date of mailing of the international search report
04 JANUARY 1996	21 FEB 1996
Name and mailing address of the ISA/US Commissioner of Patents and Trademarks Box PCT Washington, D.C. 20231 Facsimile No. (703) 305-3230	Authorized officer SUMATI LEFKOWITZ Telephone No. (703) 308-7790

Form PCT/ISA/210 (second sheet)(July 1992)*

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US95/12287

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No
Y	US, A, 5,335,338 (PROESEL) 02 August 1994, see figures 3A and 3B and col. 3, lines 64-68, col. 4, lines 1-6, col. 6, lines 53-64.	17-26, 38-42
A	US, A, 4,972,470 (FARAGO) 20 November 1990, see abstract and figure 2.	17-26, 38-42

Form PCT/ISA/210 (continuation of second sheet)(July 1992)*

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US95/12287

BOX II. OBSERVATIONS WHERE UNITY OF INVENTION WAS LACKING
This ISA found multiple inventions as follows:

This application contains the following inventions or groups of inventions which are not so linked as to form a single inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I, claim(s) 1-26 and 32-42, drawn to circuitry and methods for a standardized serial interface.
Group II, claim(s) 27-31, drawn to the structure of a data communication device including a modular pager.

The inventions listed as Groups I and II do not relate to a single inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:
Group I relates to the interface circuitry required to allow a data communication device including a modem and a pager to operate, whereas Group II relates to the physical structure of the pager and the data communication device.